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MERCURY STUDY IN BIG BEND

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GRANT CX 7000 40154

FINAL PROGRESS REPORT

ON

UNITED STATES DEPARTMENT OF INTERIOR

GRANT

CX 7000 40154

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March 15, 1975

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ABSTRACT

Mercury Pollution in the Rio Grande

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This work describes the establishing of bench marks for mercury in the Big Bend National Park, Terlingua Mine District area. Levels of from .02 to .3 ppm were established for the soil. Somewhat higher levels were established for the silt. There was less than 1 ppm mercury dissolved in the water. Samples of the lizard, C. tigris, were extensive analyzed and found to contain substanial amounts of mercury. Fish well below the area on the Rio Grande contain no mercury however minnows in Terlingua Creek were found to contain mercury. Samples of tadpoles, mice, and millipeds from the area also were found to contain mercury.

This grant was supported by the United States Department of Interior Grant number CX 700030102.

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The purpose of this study is to determine the levels of mercury in the environment in the Big Bend Naitonal Park and the Terlingua Mining District area. The Terlingua Mining District was a major mercury producer in the United States from 1905 to 1935. (Fig. I) Exploration mining and furnacing activities began again in 1951 ended in 1967. The only ore of economic importance is cinnabar (HgS).

The underlining purpose of this work is to establish bench marks for future research groups who are interested in the changes in mercury content of the environment. Even though the area produced a large part of the United States' mercury in the 1920's and 1930's, the ore in the area is low grade. The mines and furnaces have not been operated since 1967. The mercury levels that will be discussed are the natural levels of mercury in the soil not industrial pollutates. If the acidity of the Rio Grande changes or if industrialization of the area is proposed, the essentially dormant silt beds containing mercury may prove to be a factor in future safety considerations.

The mercury that is in the Big Bend area is essentially all bound as mercuric sulfide. This material is very insoluble in water. Extensive analysis of water samples from the area indicate no detectable mercury present. However, the soil and particularily the silt in the creeks and Rio Grande have measurable quantities of mercury present as mercuric sulfide. In the last few years research has indicated that this apparently harmless compound because of its solubility can be

Fig. 1   Big Bend National Park -- Terlingua Mining District

converted to the very toxic organo-mercuries by certain bacteria in the sludge of creeks and rivers. There are also some indications that mercuric sulfide if ingested with food, water, or air can be converted by animals and fish to more soluble mercury compounds. The data presented in this paper will indicate that mercury is being distributed by some means throughout the body of some fish and animals. This makes the problem more pressing.

The mercury in the area can not be removed. It is present throughout the area in the soil and silt. However there is evidence to indicate that the silt from this area is higher in mercury content than the soil from which it is derived. Preferential weathering of the softer cinnibar ore is indicated. This means the silt in the Rio Grande is higher in mercury content than the soil of the area. The mercury content of the lower Rio Grande silt beds is being increased with each rain. Some action may be necessary in the future to control the incoming silt from the Terlingua Mining District.

In our laboratories we have examined the problem in two phases. First, extensive soil, silt, and water samples were taken in the area to establish the mercury levels. As indicated in Figure II, we have sampled (10) sites in the area on a perodic basis for six months to establish the levels indicated. There samples were taken in both the dry season and in the wetter season. The average yearly rainfall is about five inches so there is no rainy season except this Fall. None of the water samples contained detectable levels of mercury after filteration. These values agree with similiar work done in other laboratories.

Fig. II Average Soil and Silt Analysis in ppm.

	Site	Soil	Silt
Croton Springs, Big Bend Nat. Park	1	0.029	0.075
Cottonwood Creek, Big Bend Nat. Park	2	0.022	0.013
1st Creek crossing W. Cottonwood Cr.	3	0.010	0.208
200-500 yds above Study Butte Mine	4	0.013	0.014
At Study Butte Mine overflow	5	0.038	0.039
200-500 yds from Mine on Rough Run Creek	6	0.042	0.023
Terlingua Creek Bridge	7	0.002	0.016
25-500 yds above Confluence of Terlingua Creek	8	0.025	0.145
100-500 yds below confluence of Terlingua Creek	9	0.009	0.012
Mariscal Mine Area located in Big Bend National Park	10	0.341	0

The most interesting results were obtained when the silt samples were analyzed. These samples take two forms. The dry creek bed samples and samples that were obtained by filtering running water. Note that the mercury levels are much higher in the silt samples than in the area soil samples. We have attributed this to the softness of the cinnibar deposits. Other workers have drawn similar conclusions about the preferential weathering of the softer ore. If monitering devices were placed on Terlingua Creek which would indicate the total volume of water flowing in the rainy season, it would be no problem to determine the amounts of cinnibar being added to the silt of the upper Rio Grande.

The second phase of our work was to examine the fish, animals, and insects in the Terlingua Creek area. The purpose of this work was to determine the up-take of mercury in the food chain. Extensive analysis of the lizard, Cnemidophorous tigris was completed by Mr. Danny Gallagher and Dr. James Scudday. The results of these studies are summarized in (Figure III). The lizards assumulate mercury into their systems. At this time samples are being examined in an attempt to determine if the mercury is organo-mercury or inorganic mercury. These results represent the survey of 6 sites and 377 tissue analysis. This would indicate that the up take of mercury is general in the region.

The isolation of mercury in the reproductive organs is of particular concern. The genetic consequences may be a point of future research. However, it is important to point out that this species of lizard had lived in this area for generations. The organism may have already adapted to the contamination years ago.

The second species examined was fish. Since Terlingua Creek is

dry most of the time with the exception of small pools, only small minnows are available. A large sampling of catfish was taken at Wild Horse Canyon which is some 100 miles down river from the mining district.

These results (Figure IV) indicates that the fish down river from the mining district have not assimulated mercury into their system. (Figure IV). The minnows from Terlingua Creek, however, have incorporated mercury into their system. This mercury must come either from the micro quantities of mercury dissovled in the water of from silt that has been ingested. It is very probably from the ingested silt.

The third samples examined were some mice. Samples of the brain, heart, stomach content, lung, hair and flesh were examined. In both cases the only detectable amounts of mercury was found in the liver. In one mouse 0.081 ppm of mercury was found in the liver and in the other case 0.086 ppm of mercury was found in the liver. Further specimans of mice are in the process of being analyzed.

The last group of samples were millipeds from the area. No attempt was made to dissect the samples. In a sampling of eleven millipeds an average of 0.018 ppm of mercury was found.

In conclusion, I would like to stress that the mercury we are discussing is from natural sources not man-made sources. The work had demonstrated that mercury is being incorporated into animals, fish, and insects. This process has been continuing for centuries. The living system has probably adapted in some way to living on a surface that is contaminated with mercury. What should concern us is the changes which could easily occur as man alters the environment. This study was conducted to establish the present levels in anticipation of future changes.

Fig. III Average Mercury concentrations for C. Tigris in ppm.

Tissue	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Liver	0.233	1.656	0.631	3.246	0.731	0.880
Kidney	0.494	4.943	2.052	3.458	0.849	2.170
Brain	0.580	7.517	0.455	1.626	0.301	2.033
Testes	0.957	16.620	11.157	1.061	0.649	0.761
Muscle	0.292	14.056	0.257	0.424	0.129	0.572
Skin	0.380	3.333	0.354	0.423	0.121	0.135
Stomach Content	0.234	2.173	0.246	1.016	0.254	0.138

Fig. IV AVERAGE ANALYSIS OF FISH, MINNOWS AND TADPOLES

Fish	Out of the area		No Signs of H_g Contamination <1ppB
	Terlingua Creek		
Minnows	#1	0.032 ppm H_g	
	#2	0.020 ppm H_g	
	#3	0.020 ppm H_g	
Tadpoles		0.020 ppm H_g	

As the Rio Grande Valley develops more industry and agriculture, the mercury in the silt should be considered. Higher animals in the food chain should be examined to determine the possible mercury levels. Plants that grow on the banks of the Rio Grande should be examined for mercury levels. Especially those plants that are later used as food.

This work has been supported by the U.S. Department of Interior Grant CX7000301022. The support of Big Bend National Park is also greatly appreciated.